CLAIMS

1. Dendritic polymers of generation n comprising:

- a central core § of valence m ;
- optionally generation chains branching around the core;
- an intermediate chain at the end of each generation chain that may be present or at the end of each bond around the core, where appropriate; and
- a terminal group at the end of each intermediate chain,

characterised in that said terminal group is represented by formula:

$-(A1)<[A2-P(=O)(OX)_2]_2$ (T)

wherein

-A1< represents the radical -CR< or –Heteroatom< ;

the radicals A2, which may be identical or different, each independently of the other represents a single bond or a linear or branched hydrocarbon chain having from 1 to 6 chain members, it being possible for each of said chain members optionally to be selected from a heteroatom, it being possible for each chain member to be optionally substituted by one or more substituents selected from -Alkyl, -Hal, $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -OAlkyl, -Aryl, -Aralkyl;

X represents a radical –alkyl, -Aryl, -H or $/M^+$, where M is a cation,

m represents an integer greater than or equal to 1;

n represents an integer from 0 to 12 ;

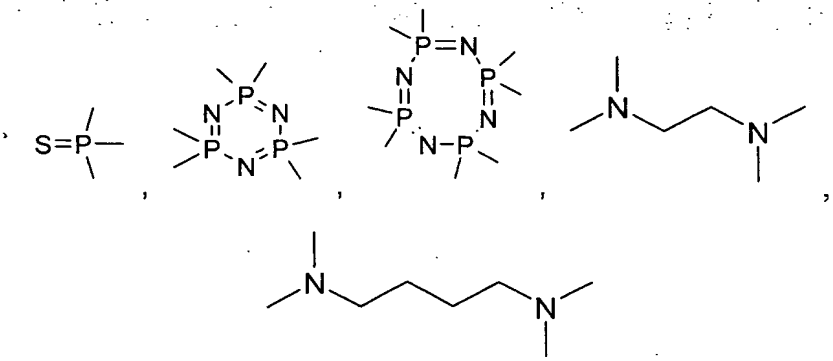
< represents two bonds situated on A1.

2 . Dendritic polymers according to claim 1 having a structure of the DAB, PAMAM or PMMH type.

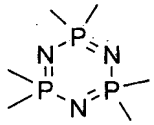
3. Dendritic polymers according to claim 1 or 2, wherein A1 represents the radical –CH< or –N<.

4. Dendritic polymers according to any one of the preceding claims, wherein A2 represents –Me-.

5. Dendritic polymers according to any one of the preceding claims, wherein the central core § is selected from the following groups:



6. Dendritic polymers according to any one of the preceding claims, wherein the central core § has the formula:



7. Dendritic polymers according to any one of the preceding claims, wherein m represents an integer from 1 to 8.

8. Dendritic polymers according to any one of the preceding claims, wherein m is selected from 3, 4 and 6.

9. Dendritic polymers according to any one of the preceding claims, wherein n is from 0 to 3.

10. Dendritic polymers according to any one of the preceding claims, wherein the generation chains are selected from any linear or branched hydrocarbon chain having from 1 to 12 chain members and optionally containing one or more double or triple bonds, it being possible for each of said

chain members optionally to be selected from a heteroatom, a group Aryl, Heteroaryl, >C=O, >C=NR, it being possible for each chain member to be optionally substituted by one or more substituents selected from -Alkyl, -Hal, $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -OAlkyl, -Aryl, -Aralkyl,

wherein

R and R', which may be identical or different, each independently of the other represents a hydrogen atom or a radical -Alkyl, -Aryl, -Aralkyl.

11. Dendritic polymers according to any one of the preceding claims, wherein the generation chains, which may be identical or different, are represented by formula:

-A-B-C(D)=N-N(E)-(P(=G))< (C1)

wherein:

A represents an oxygen, sulfur or phosphorus atom or a radical -NR-;

B represents a radical -Aryl-, -Heteroaryl-, -Alkyl-, each of which may optionally be substituted by a Halogen atom or by a radical $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -Alkyl, -Aryl, -Aralkyl;

C represents a carbon atom,

D and E, which may be identical or different, each independently of the other represents a hydrogen atom, a radical -Alkyl, -OAlkyl, -Aryl, -Aralkyl, each of which may optionally be substituted by a Halogen atom or by a radical $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -Alkyl, -Aryl, -Aralkyl;

G represents a sulfur, oxygen, nitrogen, Sulfur, Selenium or Tellurium atom or a radical =NR ;

N represents a nitrogen atom;

P represents a phosphorus atom.

12. Dendritic polymers according to claim 11, wherein in formula C1 A represents an oxygen atom.

13. Dendritic polymers according to claim 11 or 12, wherein B represents an optionally substituted phenyl radical.

14. Dendritic polymers according to any one of claims 11 to 13, wherein D represents an oxygen atom.

15. Dendritic polymers according to any one of claims 11 to 14, wherein E represents a radical –Alkyl.

16. Dendritic polymers according to any one of claims 11 to 15, wherein G represents a sulfur atom.

17. Dendritic polymers according to any one of claims 1 to 10, wherein the generation chains are represented by formula:

-A'-(C=O)-N(R)-B'-N< (C1')

wherein

A' and B' each independently of the other represents a radical -Alkyl, -Alkenyl, -Alkynyl, each of which may optionally be substituted by one or more substituents selected from -Alkyl, -Hal, $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -OAlkyl, -Aryl, -Aralkyl;

R, R' have the meaning defined hereinbefore.

18. Dendritic polymers according to claim 17, wherein A' and B' each independently of the other represents a radical –Alkyl-.

19. Dendritic polymers according to any one of claims 1 to 10, wherein the generation chains are represented by formula:

-A''-N< (C1'')

wherein

A'' represents a radical -Alkyl, -Alkenyl, -Alkynyl, each of which is optionally substituted by one or more substituents selected from -Alkyl, -Hal, $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -OAlkyl, -Aryl, -Aralkyl, wherein RR' have the meaning defined hereinbefore.

20. Dendritic polymers according to claim 19, wherein A" represents an optionally substituted radical –Alkyl-.

21. Dendritic polymers according to any one of the preceding claims, wherein the intermediate chains are selected from any linear or branched hydrocarbon chain having from 1 to 12 chain members and optionally containing one or more double or triple bonds, it being possible for each of said chain members optionally to be selected from a heteroatom, a group Aryl, Heteroaryl, >C=O, >C=NR, it being possible for each chain member to be optionally substituted by one or more substituents selected from -Alkyl, -Hal, $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -OAlkyl, -Aryl, -Aralkyl,
wherein RR' have the meaning defined hereinbefore.

22. Dendritic polymers according to any one of the preceding claims, wherein the intermediate chains are represented by formula:

-J-K-L- (C2)

wherein

J represents an oxygen atom, a sulfur atom or a radical -NR-;

K represents a radical -Aryl-, -Heteroaryl-, -Alkyl-, each of which may optionally be substituted by a Halogen atom or by a radical $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -Alkyl, -Aryl, -Aralkyl;

L represents a linear or branched hydrocarbon chain having from 1 to 6 chain members and optionally containing one or more double or triple bonds, it being possible for each of said chain members optionally to be a heteroatom, it being possible for each chain member to be optionally substituted by one or more substituents selected from -Alkyl, -Hal, $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -OAlkyl, -Aryl, -Aralkyl,
wherein RR' have the meaning defined hereinbefore.

23. Dendritic polymers according to claim 22, wherein J represents an oxygen atom.

24. Dendritic polymers according to either claim 22 or claim 23, wherein K represents an optionally substituted –Phenyl- radical.

25. Dendritic polymers according to any one of claims 22 to 24, wherein L represents a radical $-(Alk)_a-$ or the radical $-C(D)=N-N(E)-(Alk)_a-$.

26. Dendritic polymers according to any one of claims 1 to 21, wherein the intermediate chains are represented by formula

-A'-(C=O)-N(R)-B'- (C2')

wherein A', B', R, R' have the meaning defined in claim 17 or 18.

27. Dendritic polymers according to any one of claims 1 to 21, wherein the intermediate chains are represented by formula

-A''- (C2'')

wherein

A'' has the meaning defined in claim 19 or 20.

28. Dendritic polymers according to any one of the preceding claims, wherein M^+ represents a cation of an element of group IA, IIA, IIB or IIIA of the periodic table or a cation of a nitrogen-containing base.

29. Dendritic polymers according to any one of the preceding claims, wherein M is selected from the atoms sodium and potassium.

30. Dendritic polymers according to any one of the preceding claims, wherein the generation chains are identical.

31. Dendritic polymers according to any one of the preceding claims, wherein in formulae (C1) and (C2), J and K are equal to A and B, respectively.

32. Dendritic polymers according to any one of the preceding claims which are represented by the following formula (I):

§-{{A-B-C(D)=N-N(E)-(P(=G))<}^{n}[J-K-$(Alk)_a$-N<[A2-$P(=O)(OX)_2]_2]_2\}_m$ (I-1i)

in which:

§, A, B, C, D, E, G, N, P, J, K, X, A2, m, n have the meaning defined in the preceding claims, {}^{n} denotes the branched structure of the generation n chains of said dendritic polymer, and a represents 0 or 1.

33. Dendritic polymers according to any one of claims 1 to 31 which are represented by the following formula (I-1ii):

§-{{A-B-C(D)=N-N(E)-(P(=G))<}^{n}[J-K-C(D)=N-N(E)-$(Alk)_a$-CH<[A2-$P(=O)(OX)_2]_2]_2\}_m$ (I-1ii)

in which:

§, A, B, C, D, E, G, N, P, J, K, X, A2, m, n have the meaning defined in the preceding claims, {}^{n} denotes the branched structure of the generation n chains of said dendritic polymer, and a represents 0 or 1.

34. Dendritic polymers according to any one of claims 1 to 31 which are represented by the following formula (I-2):

§-{{A'-(C=O)-N(R)-B'-N<}^{n} [A2-$P(=O)(OX)_2]_2]_2\}_m$ (I-2)

in which:

§, A', B', C, N, P, X, A2, m, n have the meaning defined hereinbefore and {}^{n} denotes the branched structure of the generation n chains of said dendritic polymer.

35. Dendritic polymers according to any one of claims 1 to 31 which are represented by the following formula (I-3):

§-{{A''-N<}^{n} [A2-$P(=O)(OX)_2]_2]_2\}_m$ (I-3)

in which:

§, A'', N, P, X, A2, m, n have the meaning defined in the preceding claims and {}^{n} denotes the branched structure of the generation n chains of said dendritic polymer.

36. Method for preparing dendritic polymers according to any one of the preceding claims, comprising:

(i) reacting the corresponding dendritic polymer having a terminal function -CHO, -CH=NR, $-NH_2$ or $-P(=G)Cl_2$

with a corresponding compound having one or two functionalities $-PO_3X_2$;

(ii) optionally followed, when X represents H or M, by a step which comprises converting the dendritic polymer obtained in (i) having a $-PO_3Me_2$ termination into the corresponding dendritic polymer having a $-A1<[A2-P(=O)(OH)_2]_2$ termination,

(iii) optionally followed, when X represents M, by a step which comprises converting the dendritic polymer obtained in (ii) having a $-A1<[A2-P(=O)(OH)_2]_2$ termination into the salt of the corresponding dendritic polymer having a $-A1<[A2-P(=O)(OM)_2]_2$ termination.

37. Method for preparing dendritic polymers according to claim 36, wherein, when the dendritic polymer according to the invention is represented by formula (I-1i)

$$§-\{\{A-B-C(D)=N-N(E)-(P(=G))<\}^n[J-K-(Alk)_a-N<[A2-P(=O)(OX)_2]_2]_2\}_m \qquad (I\text{-}1i)$$

in which §, A, B, C, D, E, G, N, P, J, K, A2, Alk, X, a, m, n, < have the meaning defined hereinbefore,

step (i) comprises reacting with the corresponding dendritic polymer of the same generation n of formula

$$§-\{\{A-B-C(D)=N-N(E)-(P(=G))<Y_2\}^n \qquad (II\text{-}1i)$$

wherein Y represents -Cl ;

a compound of formula $H-J-K-(Alk)_a-N<[A2-P(=O)(OX)_2]_2$ (III).

38. Method according to claim 37, wherein the reaction is carried out in solution in a polar aprotic solvent, in the presence of an organic or inorganic base, at a temperature of from -80°C to 100°C.

39. Method according to claim 36, wherein, when the dendritic polymer according to the invention is represented by formula (I-2) or (I-3):

$$§\text{-}\{\{A'\text{-}(C{=}O)\text{-}N(R)\text{-}B'\text{-}N{<}\}^n\,[A2\text{-}P(=O)(OX)_2]_2]_2\}_m \qquad (I\text{-}2)$$

or

$$§\text{-}\{\{A''\text{-}N{<}\}^n\,[A2\text{-}P(=O)(OX)_2]_2]_2\}_m \qquad (I\text{-}3)$$

in which §, A', A'', B', B'', C, N, P, A2, X, m, n, < have the meaning defined hereinbefore, step (i) comprises reacting with the corresponding dendritic polymer of the same generation n of formula

$$§\text{-}\{\{A'\text{-}(C{=}O)\text{-}N(R)\text{-}B'\text{-}NH_2\}^n\}_m \qquad (II\text{-}2)$$

or

$$§\text{-}\{\{\text{-}A''\text{-}NH_2\}^n\}_m \qquad (II\text{-}3)$$

a compound of formula $H\text{-}P(=O)(OX)_2$ (IV) ,

in the presence of a corresponding compound H-A2-(C=O)H.

40. Method according to claim 39, wherein the reaction is carried out at a temperature of from -5°C to the reflux temperature of the mixture.

41. Method according to claim 36, wherein, when the dendritic polymer according to the invention is represented by formula (I-1ii)

$$§\text{-}\{\{A\text{-}B\text{-}C(D){=}N\text{-}N(E)\text{-}(P(=G)){<}\}^n[J\text{-}K\text{-}C(D){=}N\text{-}N(E)\text{-}(Alk)_a\text{-}CH{<}[A2\text{-}P(=O)(OX)_2]_2]_2\}_m \qquad (I\text{-}1ii)$$

in which:

§, A, B, C, D, E, G, N, P, J, K, L, X, A2, m, n, a have the meaning defined hereinbefore,

step (i) comprises reacting with the corresponding dendritic polymer of formula

$$§\text{-}\{\{A\text{-}B\text{-}C(D){=}N\text{-}N(E)\text{-}(P(=G)){<}\}^n\text{-}[J\text{-}K\text{-}L']_2\}_m \qquad (II\text{-}1ii)$$

wherein L' represents a radical -CHO ;

a compound of formula $(Alk')_a\text{-}CH\text{-}[A2\text{-}P(=O)(OX)_2]$ (VI)

wherein Alk' corresponding to Alk defined hereinbefore in formula (I-1ii) represents a radical Alkenyl, and X has the meaning defined hereinbefore, in the presence of a compound of formula

$$H_3C\text{-}NH\text{-}NH_2 \qquad \text{(VII)}.$$

42. Method according to claim 41, wherein the reaction is carried out in a polar aprotic solvent medium, by addition of the compounds (VI) and (VII) to the dendritic polymer (II-1ii) at a temperature of from -80°C to 100°C.

43. Method for preparing dendritic polymers according to any one of claims 36 to 42, wherein step (ii) is carried out:

- by the action of a trimethylsilane halide,
- followed by the action of anhydrous MeOH, which is added to the reaction mixture.

44. Preparation method according to claim 43, wherein the procedure is carried out in a polar aprotic organic solvent by addition of the trimethylsilane halide while keeping the reaction mixture at a temperature of from -80°C to 50°C.

45. Method for preparing dendritic polymers according to any one of claims 36 to 44, wherein in step (iii) salts of compounds according to the invention are obtained starting from compounds according to the invention having a terminal group in which X represents a hydrogen atom.

46. Method for preparing dendritic polymers according to claim 45, wherein the procedure is carried out in solution, in a suitable polar protic or aprotic solvent, in the presence of an organic or inorganic base, depending on the salt that is desired.

47. Compounds of formula (III):

$$H\text{-}J\text{-}K\text{-}(Alk)_a\text{-}N\text{<}[A2\text{-}P(=O)(OX)_2]_2 \qquad \text{(III)}$$

in which

X represents a radical –Alkyl, -Aryl, H or M^+, wherein M^+ is a cation;

J represents an oxygen atom, a sulfur atom or a radical -NR-;

K represents a radical -Aryl-, -Heteroaryl-, -Alkyl-, each of which may optionally be substituted by a Halogen atom or by a radical $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -Alkyl, -Aryl, -Aralkyl ;

the radicals A2, which may be identical or different, each independently of the other represents a single bond or a linear or branched hydrocarbon chain having from 1 to 6 chain members, it being possible for each of said chain members optionally to be selected from a heteroatom, preferably nitrogen, it being possible for each chain member to be optionally substituted by one or more substituents selected from -Alkyl, -Hal, $-NO_2$, -NRR', -CN, $-CF_3$, -OH, -OAlkyl, -Aryl, -Aralkyl;

-Alk- represents an alkyl radical;

a represents 0 or 1.

48. Method for preparing a compound of formula (III) according to claim 47, comprising the following step:

$$H\text{-}J\text{-}K\text{-}(Alk)_a\text{-}NH_2\ (VIII) + H\text{-}A2'\text{-}(C{=}O)H\ (V) + H\text{-}P(=O)(OX)_2\ (IV) \rightarrow H\text{-}J\text{-}K\text{-}(Alk)_a\text{-}N{<}[A2\text{-}PO_3X_2]_2\ (III)$$

wherein, in formula (V), -A2'- is a radical corresponding to A2.

49. Method according to claim 48, wherein the procedure is carried out by addition of the compounds (VIII) and (IV), and of the compound (V), at a temperature of from –5 to 25°C.

50. Use of a dendritic polymer according to any one of claims 1 to 35 for treating or being in contact with surfaces.

51. Use according to claim 50, wherein said surfaces are metal, silica-based or oxide-based.

52. Use according to claim 50 to 51, for which said dendritic polymer is used as an additive in a composition that is to be in contact with or to treat said surface.

53. Use according to any one of claims 50 to 52, according to which said dendritic polymer is used as an anti-corrosive agent, a lubricating agent, a scale preventer or as a flame retardant.